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APPLICATION FOR UNITED STATES LETTERS PATENT

PISTON-CYLINDER ASSEMBLY HAVING AN ADJUSTING DEVICE

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a piston-cylinder assembly in conjunction with an adjusting device including an actuator and a force transmitting element for transmitting adjusting force from the actuator to the piston-cylinder assembly, the element engaging concentrically on one of the piston and the cylinder.

2. Description of the Related Art

FR 2 730 714 discloses a piston-cylinder assembly in the form of a gas spring in conjunction with an adjusting device for the opening and closing of a vehicle tailgate. The adjusting device includes a Bowden cable which is actuated by a winding-up device. The Bowden cable is guided within a cylinder which has an axially movable piston rod.

A gas spring which is known per se is assigned parallel to the adjusting device in spatial and functional terms and exerts an actuating force in the direction of extension of the piston rod of the adjusting device.

One disadvantage of this assembly combination is the structural space which is required. There is already only a restricted structural space in any case just for the gas spring in a motor vehicle. Furthermore, the costs for the adjusting device, but also the additional frictional forces on the piston and on the piston-rod guide of the adjusting device have to be taken into consideration.

The object of the present invention is to realize a gas spring in which the structural outlay for the adjusting function is reduced.

SUMMARY OF THE INVENTION

According to the invention, this object is achieved in that the force-transmitting means engages concentrically on one of the two subassemblies of the piston-cylinder assembly.

With the force-transmitting means connected concentrically, owing to the configuration of the system transverse forces can be prevented or at least very greatly reduced. As a result, the service life of the gas spring can be increased in comparison with the prior art.

Provision is made for the force-transmitting means to be connected centrally in the piston-cylinder assembly. The advantage of this measure resides in the fact that firstly, part of the force-transmitting means lies in a protected manner in the interior of the piston-cylinder assembly, and secondly, when it is used, for example in furniture, design requirements are satisfied.

In one embodiment, an extension projecting out of the end of the cylinder is formed on the piston rod. The advantage of this measure resides in the fact that an extension can be sealed more easily than the force-transmitting means, which is formed, for example, by a Bowden cable or a threaded rod or a rack.

In a further structural refinement, the cylinder has a piston-rod guide for the piston rod and a guide for the extension. The piston rod therefore has particularly good radial guidance.

The extension optionally has a stroke-limiting stop for the piston rod. Using a single embodiment of the piston-cylinder assembly, the stroke of the piston rod can therefore be adapted in different applications and standardization can therefore be achieved.

According to one advantageous embodiment, the stroke-limiting stop is formed by a sleeve. One development resides in the fact that the sleeve enters into a threaded connection with the extension and can therefore be adjusted in an infinitely variable manner.

In a further embodiment, the piston rod is of hollow design and accommodates a connection which is connected at one end to the cylinder and at the other end to the force-transmitting means. Even when the piston rod is extended to the maximum, a section of the connection still remains within the hollow piston rod, with the result that the connection and the piston rod can very easily be sealed with respect to each other.

In order to obtain a connecting surface which is as large as possible, but can be produced in a structurally simple manner, the connection has a flange which is connected to the cylinder.

In this case, provision is advantageously made for the flange to be fastened to a bottom of the cylinder. The flange can be arranged directly on the bottom and can improve the latter with regard to mechanical strength.

In order to simplify the access of the force-transmitting means to one of the subassemblies of the piston-cylinder assembly, at least one of the subassemblies has a radial connecting element for the fastening.

In a further embodiment, provision is made according to the invention for the cylinder to have a capsule element which is arranged concentrically with respect to the piston rod and accommodates the force-transmitting element, the force-transmitting element being guided through the piston rod, which is of hollow design, as far as a fastening point.

This variant achieves the advantage that the piston-cylinder assembly can be regarded as a simple covering for the force-transmitting element. Consequently, it is not possible for any transverse forces at all or other loads to be transmitted by the force-transmitting element to the piston-cylinder assembly.

In order to guide the force-transmitting element in as precise a manner as possible, the capsule element extends into the piston rod. The capsule element can be sealed by simple means against the ingress of operating medium from the cylinder.

In this case, provision is advantageously made for the capsule element to be formed by a tube. During an operating movement of the piston rod, the piston rod telescopes simultaneously with the capsule element.

In order not to have to accept any loss in stroke length, the capsule element is fastened to the bottom of the cylinder.

Furthermore, provision is made, with regard to a low amount of friction between the piston rod and the capsule element, for the capsule element to be mounted in a manner such that it can be moved at an angle.

Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. It should be further understood that the drawings are not necessarily drawn to scale and that, unless otherwise indicated, they are merely intended to conceptually illustrate the structures and procedures described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a basic illustration of an actuating system having the piston-cylinder assembly according to the invention;

Fig. 2 shows a piston-cylinder assembly according to Fig. 1 as an individual part;

Fig. 3 shows a detailed modification of the piston-cylinder assembly according to Fig. 2; and

Figs. 4 and 5 show an alternative design of the piston-cylinder assembly according to the invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Fig. 1 shows an actuating system which contains a piston-cylinder assembly 1 in the form of a gas spring. The actuating system can be used, for example, for the opening and closing movement of a vehicle door or vehicle tailgate. The piston-cylinder assembly has a cylinder 3 as one subassembly and a piston rod 5 as a second subassembly, the piston rod being movable axially relative to the cylinder. The cylinder is filled with a gaseous pressure medium, with the result that a pushing-out force acts on the piston rod. Each of the two subassemblies has a connecting element 7; 9, the connecting element 7 mounted on the cylinder being designed in the form of a pivot bearing radially. With regard to the above-mentioned exemplary embodiment, the pivot bearing 7 can be fastened on a vehicle body and the connecting bearing 9 can be fastened on a vehicle tailgate.

Furthermore, the actuating system comprises an adjusting device 11 which contains a motor 13 as the actuator and a Bowden cable 15 as the force-transmitting means. In addition, the actuator is assigned a coupling 17 and a rolling-up mechanism 19 which contains a spring (not illustrated), in order to achieve a rotational movement of the rolling-up mechanism with the motor disconnected. Control electronics 21 in conjunction with at least one sensor 23 which detects the movement of the tailgate influence the operation of the actuator.

The piston-cylinder assembly exerts an actuating force in the direction of extension of the piston rod 5. In contrast, the actuator together with the force-transmitting means acts counter to the actuating force of the piston-cylinder assembly and enables the piston rod to be retracted again. The force-transmitting means or the Bowden cable 15 is supported axially against a stop 25. Between the stop and a connection 27 of the Bowden cable on the piston-

cylinder assembly 1 there is a spacing corresponding at least to the stroke length of the piston rod.

The invention is in no way restricted to an actuator in the form of a motor. A simple, manually operated crank could also be used. The force-transmitting means could also be of different design, by a rack, for example, being used.

Figure 2 is restricted in its illustration to the piston-cylinder assembly according to Fig. 1. The piston rod 5 has a piston 29 which divides the cylinder into two working spaces 31; 33. Starting from the piston, an extension 35 extends through the working space 33 as far as the connection 27 situated outside the cylinder. The extension is dimensioned in such a manner that even when the piston rod is extended to the maximum, the connection is not prestressed against the piston-rod guide. Furthermore, the extension engages concentrically on the piston or the piston rod, with the result that it is not possible for any transverse forces to occur on the extension during an adjusting force. In order for it to be possible for the extension to be fastened concentrically to the piston with little structural outlay, the connecting element 7 is designed as a radial pivot bearing. As an alternative, the guide 39 could also have a pin joint 40 which contains a central channel 42 in which the extension 35 can be displaced, as is illustrated in the basic diagram in Fig. 3.

A piston-rod guide 37 is provided for the piston rod 5. The extension is also centered in a guide 39 which has a seal 41 in order to seal the working spaces with respect to the atmosphere.

A stroke-limiting stop 43 is fastened to the outer end of the extension 35 and is used to determine the usable stroke length of the piston-cylinder assembly. The stroke-limiting

stop is formed by a sleeve which can differ in length. The distance a; b or c on the end side from the piston-rod guide determines the stroke length of the piston-cylinder assembly. As an alternative, the sleeve can also form a threaded connection 45 with the extension, so that the usable stroke length can be set in an infinitely variable manner within limits.

Fig. 4 illustrates a modification of Fig. 2. The essential difference from Fig. 2 is that the piston rod 5 is of hollow design all the way through and accommodates the connection 27. The connection has a flange 47 which is fastened to the bottom 49 of the cylinder. The length of the connection 27 is dimensioned in such a manner that it protrudes over the open end of the piston rod at every possible stroke length of the piston rod. In order not to permit any loss of operating medium to arise, the seal 41 is arranged between the hollow piston rod and the connection 27, this seal sealing the annular gap necessary for the relative movement between the extension and the piston rod. In this case, the piston rod has a radial connecting element 9 in the form of a pivot bearing. With regard to the piston rod, in the event of an effective adjusting force from the force-transmitting means 15, the cylinder 3 is drawn in the direction of the piston.

Fig. 5 shows a modification of Fig. 4. Instead of the connection 27, use is made of a capsule element 51 in the form of a tube which penetrates the bottom 49 of the cylinder 3 and therefore makes the option of passing through the force-transmitting element 15 possible. In order to be able to compensate for small angular errors of the capsule element 51 with regard to the piston rod 5, the capsule element has an elastic bearing point 53 which can be formed, for example, by an elastomer ring 55. An elastomer ring of this type affords the advantage of sealing the working space 33 in the region of a central opening 57 in the bottom for the capsule element.

By means of injection molding, a simple and nevertheless durable and fluid-tight connection can be achieved between the elastomer ring and the capsule element.

In every stroke position of the piston rod, the capsule element 51 protrudes into the piston rod 5, the piston rod, after it has extended for a certain amount, also constituting a capsule element with regard to the force-transmitting element.

In this exemplary embodiment, the two connecting elements 7; 9 are designed as radial pivot bearings, with other connecting forms being perfectly possible.

The force-transmitting element 15 is connected directly at a fastening point 61 to the element to be moved, for example the vehicle tailgate 59. The piston-cylinder assembly is therefore used merely as a covering which does not have to absorb any forces of the force-transmitting element. A further advantage of this solution resides in the fact that the piston-cylinder assembly can be aligned completely independently of the direction of force of the force-transmitting element 15, i.e., if staying with the exemplary embodiment mentioned a number of times, either the cylinder 3 or the piston rod 5 can be fastened in an articulated manner to the tailgate. No differences arise as a result for the functioning of the force-transmitting element.

Thus, while there have shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be

recognized that structures and/or elements and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.